

OLLSCOIL NA hÉIREANN GAILLIMH
NATIONAL UNIVERSITY OF IRELAND GALWAY

AUTUMN EXAMINATIONS 2010

Bachelor of Science in Information Technology

ARTIFICIAL INTELLIGENCE (CT421) - 4IF1

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Time allowed: *three* hours.

Attempt *two* questions from section A AND *two* questions from section B.

SECTION A

1. (a) Given the following database:

distance(galway, oranmore, 5).

distance(oranmore, loughrea, 17).

distance(loughrea, ballinasloe, 18).

distance(galway, oughterard, 17).

distance(galway, claregalway, 6).

distance(claregalway, tuam, 14).

where *distance(X, Y, Z)* is defined as the distance between place *X* and place *Y* is *Z* miles.

- (i) Write a rule *find_distance(X, Y, Z)* which returns the distance between two adjacent towns. Your rule should work for both directions.

For example the query:

find_distance(galway, oranmore, Dist).

would give the result:

Dist = 5

and the query:

find_distance(loughrea, oranmore, Dist).

would give the result:

Dist = 17

- What results would your rule return in answer to the query:

find_distance(X, Y, 17).

(5 marks)

- (ii) Write a rule *long_distance(X, Y, Z)* which checks that the distance between towns *X* and *Y* is *Z*. Your rule should allow for longer journeys, for example the query:

long_distance(tuam, galway, Dist).

would give the result:

Dist = 20

- What results would your rule return in answer to the following queries:

long_distance(ballinasloe, tuam, X).

long_distance(Galway, loughrea, X).

long_distance(X, Y, Z).

(7 marks)

- (b) Describe the mechanism Prolog uses to attempt to satisfy queries. Illustrate your answer with an example.

(4 marks)

- (c) Describe the Closed World Assumption, in particular discuss its effect on Prolog.

(4 marks)

2. (a) Write a Prolog predicate, `sum(X,Y)`, that takes two arguments. The first of these arguments is a list of integers. Return the sum of these integers as the second argument.
(8 marks)
- (b) What will your code do for the following calls:
- (i) `sum([1,2,3,4],X)`.
 - (ii) `sum([1,3,5,7],12)`.
 - (iii) `sum([[1,2,3,4]],X)`.
 - (iv) `sum(X,[1,2,3,4])`.
- (4 marks)
- (c) Write a Prolog predicate that reverses the list contained in the first argument, and returns it as the second argument.
(8 marks)

3. (a) Explain what is meant by Qualitative Reasoning. What are its advantages and disadvantages.
(3 marks)
- (b) Give an example of an application where Qualitative Reasoning would be suitable. Justify your answer.
(2 marks)
- (c) Give an example of an application where Qualitative Reasoning would not be suitable. Justify your answer.
(2 marks)
- (d) Given the following constraints (which represent the motion of a ball being thrown in the air):

$$DERIV(x, v)$$

$$DERIV(v, a)$$

$$a = g < 0$$

and the quantity spaces:

$$\{-\infty, 0, \infty\} \text{ for } v$$

$$\{0, top\} \text{ for } x$$

If the initial state is:

$$QS(x, t_1) = \langle top, std \rangle$$

$$QS(v, t_1) = \langle 0, dec \rangle$$

$$QS(a, t_1) = \langle g, std \rangle$$

What are the possible next states?

Rule-id	$QS(v, t_i)$	$QS(v, t_i, t_{i+1})$
P1	$\langle l_i, std \rangle$	$\langle l_i, std \rangle$
P2	$\langle l_i, std \rangle$	$\langle (l_i, l_{i+1}), inc \rangle$
P3	$\langle l_i, std \rangle$	$\langle (l_{i-1}, l_i), dec \rangle$
P4	$\langle l_i, inc \rangle$	$\langle (l_i, l_{i+1}), inc \rangle$
P5	$\langle (l_i, l_{i+1}), inc \rangle$	$\langle (l_i, l_{i+1}), inc \rangle$
P6	$\langle l_i, dec \rangle$	$\langle (l_{i-1}, l_i), dec \rangle$
P7	$\langle (l_i, l_{i+1}), dec \rangle$	$\langle (l_i, l_{i+1}), dec \rangle$

(10 marks)

- (e) What discrete states would the ball pass through after being thrown up into the air?
(3 marks)

SECTION B

4. (a) Explain how the A* algorithm works?
(7 marks)
- (b) A zone equivalency array is often used to indicate what may be traversed in game levels. Consider a game that has the following three types of terrain: land, water, impassible. Illustrate how such arrays work by considering zone arrays for (1) a land and (2) an amphibious vehicle.
(7 marks)
- (c) In a level with many nodes, what technique might be brought to bear to reduce the search burden in your view?
(6 marks)
5. (a) What is meant by the term finite state machine?
(6 marks)
- (b) Explain the child state competes control model for state transitions
(6 marks)
- (c) Sketch the development of a finite state machine for a soccer player. There should be at least an attacking behaviour and a defending behaviour.
(8 marks)
6. (a) In the context of genetic algorithms, what is meant by the term fitness function?
(6 marks)
- (b) Explain the role of randomness in roulette wheel selection
(6 marks)
- (c) You are tasked with developing an offline genetic algorithm to safely land a spacecraft. Sketch the principal elements that would inform your development.
(8 marks)